disease has been known on the continent for the last twenty years, and notwithstanding that "Governments had taken up the matter," we are no wiser as to the life-history of the parasite than they were in Germany at starting. Nor if we were should we be probably any better off, however interesting the result might be from a scientific point of view. For each phase of such a fungus has apparently an indefinite capacity for propagating itself independently. The rust of wheat is as destructive in Australia as anywhere else, and is not checked by being unable to complete its life-history on the barberry.

It is not material, but it may be noted that Gnomonia belongs to a group of fungi widely remote from the rust of wheat. I can hardly believe that Mr. Carruthers intended to suggest that they belonged to the same "class."

But my object in drawing attention to the matter is to remonstrate with my scientific friends for the mistaken policy which it seems to me that many of them are too apt to adopt in matters of this kind. It is the fashion now to clamour for "State-paid" assistance for everything, with no sense of the relative importance of the objects aimed at or appreciation of the work which is actually being done. It is most important that Government aid should be obtained for a definite purpose, such as that of the National Physical Laboratory. But if scientific men will not even give the Government credit for the aid it gives, they run the risk of being regarded as impossible to satisfy.

In his report, published by the Royal Agricultural and Horticultural Societies, Mr. Carruthers states:—"The neglect of undertaking this operation (burning of the dead leaves), though costly, means the disappearance of the cherry orchards of Kent in a very few years." In the face of this very serious statement it is remarkable that, so far as I can ascertain, no information on the subject has reached the Board of Agriculture.

Kew, January 22. W. T. THISELTON-DYER.

Variation in Fowls.

EVERYONE who is acquainted with poultry must join Mr. Tegetmeier in deprecating the economic degradation of good old breeds by breeding for fancy points only (p. 152). But it is an ill wind that blows nobody good, and from a scientific point of view a decadent old breed with exaggerated points is more interesting than one of the comparatively useful modern mongrels produced by crossing, since the former shows conclusively what can be done by sheer selection, even though applied for a senseless end.

Fortunately, Mr. Tegetmeier has given excellent comparative views of some breeds before and after "improvement" in his work on "Table and Market Poultry"; but if the old strains are obtainable anywhere in their primitive form it would be, I think, very desirable to get specimens and preserve them, together with some modern highly-bred birds, for the benefit of bionomical students when the declining breeds have become extinct. Meanwhile, I should like to draw the attention of students of variation to the great differences observable in domestic fowls which have not been subjected to any selection, such as the ordinary poultry of India. Among these, although they are allowed to breed anyhow, may be seen all recognised colours of fowls except those of the highly specialised laced, pencilled and spangled breeds, which have needed a long course of selection. Double or "rose" as well as single combs occur, although the latter are a minority, and small crests are common. Five toes and feathered legs are rare; the legs vary much in tint.

Now, in Egypt, I have observed that, while equally variable in coloration, the fowls displayed some structural points peculiarly their own. The combs are very often *really* double; not the coral-like "rose" comb, but a bifid or two-flapped edition of the normal compressed and serrated form. The hind toe also was very often bifid, exhibiting every gradation from the five distinct toes of the Dorking to a distally split hind toe or one in which the normal hallux was represented by a mere terminal joint with a nail, growing from the long upper supernumerary hallux. Indeed, I even got a specimen in which the extra hallux alone remained, the true first digit having disappeared altogether! The consequence was that this bird's foot looked like a curassow's, but I observed that it had very little power of grasping therewith.

In Zanzibar I again found poultry of every colour, but very true to the lanky, close-feathered, small-combed Malay or Chittagong type, which thus seems to maintain itself in spite of neglect by breeders.

What is particularly noticeable in casually-bred poultry is the correctness of some of the types of marking. Thus the silver-grey variation, in the cock, resembles the typical black-breasted red in everything except in that the red parts of the plumage are changed to white. The corresponding hen has the brown and yellow of the upper surface also replaced by white, and hence is grey in tone with a silver-streaked hackle.

When such correlated grey and rufous forms occur in wild gallinaceous birds, they are put down as climatic variations, but it is obvious that climate cannot be the *direct* cause, though it may favour the survival of one type rather than the other, according to constitution or surroundings.

Another common style of marking found in two colours is that in which the base of the neck, the primary quills and the tail are chiefly black in both sexes, the rest of the body being uniform, either white or some rufous shade ranging from bay to buff. This coloration might easily characterise a natural species, although it is not known to do so; in accepted breeds the white form has been adopted as the proper colour for the light brahma, and the cock of the golden-pencilled Hamburg breed closely approximates to the black-tailed rufous form. Hens of the black-tailed red type are, however, not recognised in any breed.

A very common and curious variation in rough-bred fowls is the "wheaten" hen. This bird is of the pale-brown colour of wheat, with a dark-brown neck and black tail; but the correlated cock is a black-breasted red of the jungle-fowl colour. This colour of the hen is recognised in Malays and old English game, and is said to breed the brightest cocks.

It has occurred to me that the occurrence of two such distinct types of hens as the "wheaten" and the "partridge" (the name given to hens of the jungle-fowl brown) in correlation with similarly coloured cocks may, perhaps, help to explain the phenomenon of dimorphism in female butterflies. For if we knew the pedigree of these insects as well as fanciers do that of their fowls we might very possibly find that in dimorphic species two strains with dissimilar females but similar males existed and interbred.

So, also, the great and sudden variations throw light on the origin of mimicry. The form of the fowl with white body and black quills and tail, above alluded to, is similar in plan of coloration to several large and powerful birds. If such a variation occurred where the form and flight were favourable to mimicry, as it might easily do among the multitudes of passerine birds, we should have mimics ready-made.

The problem in the case of butterflies is much easier, owing to their greater general similarity of shape; but in any case it is obvious that variation is more important than selection here.

Indian Museum, Calcutta. F. FINN.

Elementary School Mathematics.

THE appointment of a committee of the British Association on the teaching of elementary mathematics encourages the hope that that body will be able, after collecting the opinions of practical educators, to focus them with due wisdom into a scheme which will be generally acceptable, both to teachers and examiners. For success to be attained it is obviously necessary that those who are in actual touch with the work of teaching should state what, in their judgment, is desirable and practicable. Hoping that others besides myself will follow the example set some time ago by Mr. Hurst of Eton, I venture to write to NATURE a sketch of the conclusions to which an experience of many years at Charterhouse has led me.

I have in mind in what follows the needs of the average boy, not of that comparatively rare individual who has some real mathematical taste; but I am sure that the progress of the latter is at present often sadly retarded by the course of study through which he is put. Our public schools have, unhappily, as I think, no organisation for securing common action except the annual conference of head-masters, which has, so far, done very little for the cause of education, hence methods and ideals vary much; but I shall assume that the average character of what is taught may be gathered from the papers set in the various public examinations for which we all prepare, and from the most popular text-books in use. Taking this ground, I think the broad indictment must be at once admitted that school mathematics are altogether too abstract and

artificial; aiming at training the pure reason they have got out of touch with facts, and for many pupils degenerated into mere jugglery with symbols cast loose from thought; hence they fail to interest and influence all but a very few. Look at the questions set in any of the well-known examinations—and see how many of them consist of stock puzzles of more or less complexity, invented, apparently, solely in order that successive generations of boys may learn how to deal with them, score marks by them, and then lay them aside as useless! And, of course, a large portion of our text-books and our teaching is necessarily devoted to such questions. So long as the chief examinations maintain their present character a general reform of school mathematics is well-nigh impossible, and partial reforms at individual schools (I have Winchester in mind as a pioneer in endeavour) are very difficult. I will, however, briefly and without detail indicate directions in which I think real improvement can be made without introducing revolutionary changes.

The great aim must be to introduce as much as possible the concrete element, for there are few boys who cannot be interested keenly in what they can deal with in practical fashion by drawing or handling in any other way, and fewer still to whom a bare abstract idea is not repellent. Until elementary physical measurements and the mathematics appropriate for dealing with them are taught together, an arrangement much to be wished for both from the points of view of science and mathematics, the best field for the introduction of the concrete is undoubtedly geometry.

In all the earlier stages of geometrical work, theory should always be kept in touch with practice by much drawing and measuring of figures; this, I am convinced, is the best way of building up exact geometrical ideas, and it has besides the great advantage of being intensely interesting to boys. I do not refer to "geometrical drawing" as often taught and usually understood in examinations which aims merely at making certain constructions (though this gives a valuable bit of training to those who have too often no notion of using their hands efficiently for any purpose not connected with a ball), but I would have it used always concurrently with, and in illustration of, demonstrative geometry. This is, I know, quite possible, though I have as yet come across no text-book in which it is done.

In theoretical geometry the only serious divergences from Euclid's methods I would advocate are (1) the introduction from the first of the idea of an angle as generated by a rotation, and (2) the substitution of the arithmetical and algebraical treatment of proportion for Euclid's.

Euclid's test of proportion, which appeals so strongly to the grown mathematician by its elegance and completeness, is for even the very best boys very difficult to grasp, and for the moderate boy a rigid insistence on it (which is practically never made) would involve an absolute bar to the discussion of similar figures and elementary trigonometry, matters which are quite easy if the difficulty of incommensurability be kept in the background. I would, however, while adhering to Euclid as the only possible text-book, omit, on a first reading at least, many of the propositions in order to push on to those which connect with, and can be illustrated by, practical work. For instance, after Book I., I would have read those propositions of Book III., some dozen or so in number, proving the angle properties of circles.

Seeing that demonstrative geometry furnishes by far the most accessible example of pure deductive logic, and for most boys the only one they will ever come in contact with, I would insist most strongly on its never being sacrificed to so-called "proofs" by measurement which are found in some books. The training of the reasoning powers is one of the highest aims of education, and with this end in view constant practice in riders is of the greatest value; the teaching of Euclid's text without this is a most deadly waste of time, and cannot be too strongly condemned.

In arithmetic I think the most important reform would be the general recognition of the fact that decimals are not adapted for exact calculation, but are preeminently valuable in approximation, which is the practically useful form.

From the first, therefore, boys should be taught to work out results correct to a few places only—generally not more than four—and all work with recurring decimals should be omitted.

Many of the puzzling questions set on such subjects as discount, stocks, &c., have very slight relation to practical life, they require much time to learn to deal with them, and should be discarded in favour of work on areas and volumes of simple figures. An equal amount of thought can be elicited, and therefore a not less amount of culture imparted, by good problems on the latter subjects, with the advantage of being more in touch with practical requirements.

In algebra I would, in the earlier stages, insist much more closely than is done at present on the accurate use of symbols as a shorthand language for expressing arithmetical operations, deferring long "sums" of multiplication, division, &c., until much work has been done on simple equations of the first degree as aids to the solution of problems. Later I would omit much of the harder manipulation with fractions and abnormal index expressions which is now taught, and in place of these devote much time to the development of the notion of one quantity as a function of another, illustrated by plotting graphs on squared paper. The theory of fractional and negative indices should be taught as leading up to logarithms to base 10, but I deprecate the too early use of these in calculation.

Arithmetical trigonometry involving functions of acute angles only, and with constant reference to four-figure tables and accurate drawings to scale, should be taught much more generally than it is now. For boys in the higher forms who are but poor mathematicians I have found it an interesting and stimulating change from the weary round of arithmetic and algebra they had trodden *ad nauseam* before. A short course of the same work should, even in the case of good boys, be preliminary to the algebraical treatment of trigonometry.

I have written only of the very lowest rungs of the mathematical ladder; those who from professorial and engineering altitudes lecture us on what we ought to teach have often no notion of the mind stratum in which the greater part of our life's labour is spent; hence their advice, and their books when they condescend to write for us, are too often hopelessly above the mark. That by cooperation of all interested some real improvements in the curriculum may enable us to get a rung or two higher all round is the earnest wish of myself and many other teachers.

J. W. MARSHALL.
Charterhouse.

The Distance of Nova Persei.

SINCE publishing, in NATURE of January 2, the suggestion that the cause of the apparent expansion of the nebula surrounding Nova Persei might be explained by the illumination of meteoric matter by the light sent out on the occasion of the outburst of the Nova, I have seen a paper published by Prof. Kapteyn in the *Astr. Nach.* (No. 3756), in which he suggests the same idea. His claim to priority in the matter is therefore clear. In my note, referred to, I give the distance of the Nova as 313 light years. In calculating this distance I made the mistake of taking the date of the outburst as February 12 instead of the 22nd. This made the distance of the Nova considerably too great.

Let D denote the distance of the Nova, and r the radius of the nebula, in *miles*; and let ρ be its radius in seconds of arc. Then we have

$$\frac{r}{D}=\frac{\rho}{206265} \therefore D=206265\times\frac{r}{\rho} \quad . \; . \; . \; . \; . \; (1)$$

But if V is the velocity of light in miles per second, and if T be the time in *days* elapsed from the outbreak of the star to the date of the photograph, then

$$r=24\times 60\times 60 \,.\, V \,.\, T \quad . \; . \; . \; . \; . \; . \; . \; (2)$$

Substituting this in (1) we find

$$D=24\times 60\times 60\times V\times 206265\times\frac{T}{\rho} \quad . \; . \; . \; . \; (3)$$

Also if L be the distance travelled over by light in a year of $365\frac{1}{4}$ days, *i.e.* a light year, then

$$L=24\times 60\times 60\times V\times 365\tfrac{1}{4} \; . \; . \; . \; . \; . \; . \; . \; (4)$$

Dividing (3) by (4) we find

$$\frac{D}{L}=\frac{206265}{365\cdot 25}\,\frac{T}{\rho}$$

or

$$D=\left[\;2\cdot 75184\;\right]\times\frac{T}{\rho}\times L, \quad . \; . \; . \; . \; . \; . \; (5)$$

the figures in brackets being the logarithm of $\frac{206265}{365\cdot 25}$.